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It's in the Bag

Digital Backpacks for Project-Based Learning

Build your own self-contained toolkits for your problem- and project-based learning experiences, complete with appropriate technology that works for every learning style.

When it comes to technology, many schools know what they want. They want targeted and scalable solutions that enhance learning and meet the NETS•S. And the teachers in those schools want simple, strategic instructional frameworks for developing their students' basic and digital age skills while meeting diverse learning needs. But as many technology integration specialists know, satisfying all those wants in every lesson is no easy task.

Undaunted, the University of Cincinnati FUSION Center set out to build a solution that fulfills all of those requirements. We partnered with the National Underground Railroad Freedom Center and Apple to develop a toolkit that is simple, scalable, effective, and even portable. We call it the digital backpack.

A digital backpack is just what it sounds like: an actual knapsack that contains an array of digital and hardware tools, resources, and instructional materials handpicked to engage learners in project- or problem-based learning (PBL) experiences. We have designed digital backpacks for specific projects and challenges as well as for projects in particular curriculum areas.

Designed to Support All Learners

Our design is grounded in the Universal Design for Learning (UDL) framework. Based on neuroscience, UDL purposefully combines the use of technology with instructional pedagogy to support

students with a range of academic abilities, disabilities, and cultural and language backgrounds. Our digital backpack design strives to align its core components with UDL principles. Each backpack provides:

- Multiple means of representation to support learner perception, understanding, and comprehension
- Multiple ways for learners to take action, express their understanding, and increase executive-level processing
- Multiple means of engagement to promote learner interest, effort, and self-regulation

Open a digital backpack, and you'll find three core components that teachers can easily adapt to increase student engagement and understanding in different curricular areas or use in interdisciplinary activities. They include:

- Foundational technology
- Modular technology
- Instructional support materials

Foundational technology. This is the hardware and software that is the core of the digital backpack. It must be flexible enough to support multiple modular technologies. Besides a well-constructed backpack, the foundational technology would include a laptop or tablet device and software or apps to access instructional content, gather data, and construct media.



Modular technology. This set of tools includes hardware, software, and devices chosen to meet specific instructional goals and desired outcomes. The modular technologies that we tested included digital camcorders, iPod touches with preloaded apps, digital sound recorders, digital science probes, measuring tape, and Pasco's Sparkvue (data-gathering and analyzing software). Other ideas include microphones and digital still cameras.

Teachers choose their technologies based on their capacity to support the individual PBL experience, and, as suggested by the term *modular*, they can add or remove a given technology from a digital backpack depending on the specific learning objectives.

It is essential for the modular technologies to be able to readily interface with the foundational technology.



When teachers purposefully embed these technologies within an instructional experience, we have found that they can increase engagement and support learners in expressing their understanding.

Instructional support materials.

These include all of the curriculum resources that provide the structure, guidance, and specific information learners need to understand the content and complete the learning experience. Teachers can change or modify the instructional support materials, just as they did the modular learning technologies, based on instructional, curricular, or student needs.

In the backpacks we tested, the instructional support materials included content-specific instructional information in the form of documents,

podcasts, videos, and content-based apps. You could include any digital learning objects, art, or artifacts as well as URLs for online resources and informational background articles. Our backpack designs have also included learner handouts to structure activities, such as storyboarding templates and activity instructions. Some instructional support materials provide technology tutorials for the foundational and modular technologies.

In the various digital backpack designs we have implemented, we have found the instructional support materials to be the most critical, yet often overlooked, component. The teacher's expertise and knowledge of students and their learning needs comes most strongly into play when they are preparing the instructional support materials, as that's what provides the basis

for students to understand the content and complete the associated experience. It is important to include multiple means of content representation as well as ways to purposefully scaffold the actual "engaged" experience. For instance, teachers can provide the students with digital templates to help facilitate data gathering or problem solving. We have found that having students use a template to storyboard as an initial part of the backpack activity helps them stay on task and better understand the content.

We created several digital backpack variations by modifying these core components to meet different sets of curricular and instructional needs. Digital instructional support materials are particularly adaptable to different learning styles, as teachers and students can access the content multiple times, convert it to numerous languages, search it, change text color and size, auto-summarize it, or have it digitally read aloud. We also designed rich tasks to go along with the technologies that encourage multiple modes of expression and engagement. Finally, we designed the backpacks to support just-in-time learning as well as information and technology skill building through the use of various types of communication, collaboration, problem solving, critical thinking, and other executive-level skills.

Digital Backpack Field Experiences

We tested the digital backpack with multiple age groups, from kindergarten through adult, and in a range of settings.

Elementary school. A group of students in kindergarten through fifth grade participated in a digital backpack experience at a nationally ranked zoo. Their instructional task was to determine how the zoo could become more kid friendly.

Because of the age and size of these young students, some left the laptops

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at school during the field trip but used them to complete the lesson once they returned. At the zoo site, the students used several modular technologies to acquire pictures, video, and audio of their observations. Student teams gathered information on zoo safety and animal habitats. Many student groups interviewed other children and families visiting the zoo.

After the visit, the students used their data to develop presentations, including simulations and models using simple programs (such as drawing in Apple's Keynote or modeling in Google's SketchUp) about how the zoo could be more kid friendly. The teachers shared the presentations with zoo administrators, who implemented some of the students' suggestions. For instance, the zoo now has a life-size cutout of a giraffe for people to compare their height to.

This example demonstrates a PBL experience. The project was open ended enough for students of different ages to engage fully and at their own learning pace. The students had to define for themselves what a kid-friendly zoo would look like and, once they had a definition in mind, how to gather data about the zoo's status based on that definition.

The experience also demonstrated a number of UDL ideas. Students had to make decisions about how to gather information (videos, pictures, and interviews), how to make sense of the data (in photos or Excel spreadsheets, for example), and finally how to represent their findings to other people.

Middle school. The integrated problem-based experience for middle school students was using their digital backpacks to catalog and gather data on fossils at a nearby fossil outcrop.

Each backpack was equipped with a laptop (they now have iPads) and task-specific modular technologies: camcorders, cameras, tape measures, and digital microscopes. The instructional support materials included fossil identification information and a project overview indicating they should collect digital images to catalog fossils. The students developed presentations depicting their fossils and findings and used this information to develop hypotheses for the types of habitats that existed during the time of the fossilized animals' lives.

As part of the design of this PBL experience, students were given different roles to increase engagement. Each contributed to the overall project by employing a different skill set. The student roles included team leader, data collector, data analyst, and presenter. (The National Center on Universal Design for Learning's guidelines further explain the idea of learner role differentiation.)

High School, college, and teachers. The task that high school and adult participants were assigned was creating a movie. The participants were told that a media company had hired them to develop a five-minute movie addressing the question "What is freedom?" with the Freedom Center as a backdrop. In a four-hour period, the participants used digital backpacks outfitted with a laptop and media-focused modular technologies, such as digital camcorders and cameras, to create their movies. The instructional

support materials included project guidelines, project templates, and multimedia background information on Freedom Center exhibits.

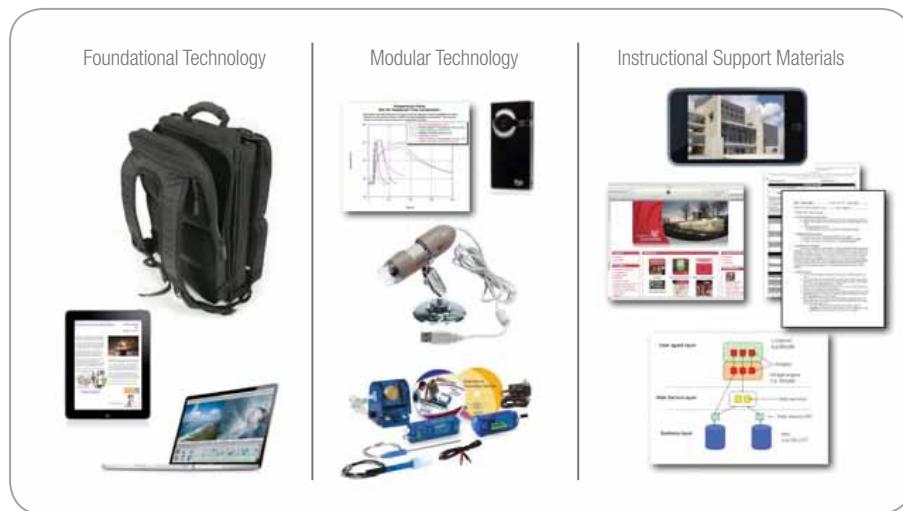
Like the zoo activity, this PBL experience demonstrated the UDL principles of supporting multiple means of representation, learner decision making about information gathering and expression, and role assignments. It was a popular and effective activity that continues to be available to all Freedom Center visitors.

Build Your Own

Although digital backpacks are relatively easy to develop and implement, you should keep a few things in mind when building your own backpack. First, it is important to think through the core components you'll need using the UDL framework. How will your backpack meet diverse learning needs? Does it provide for multiple means of representation, expression, and engagement? Each of our digital backpack designs meet diverse learning needs by including multiple ways for learners to acquire content or project information, and they often contain duplicate digital files and paper documents. You can also provide links for online tools and media, such as websites, podcasts, and videos, that learners can use to gather necessary information. The problem- or project-based learning experiences you embed in the digital backpacks should also provide alternatives for learners to engage in the project and demonstrate understanding of its content.

Second, consider how the students are actually going to use the technology. To avoid large-scale retrofitting, consider which foundational technology and modular technologies will

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Each digital backpack contains a foundational technology as well as a variety of modular technologies and support materials that teachers can adapt for the lesson, age group, and individual students' learning needs.

provide the greatest amount of flexibility and student use. Also consider time efficiency. We quickly learned that camcorders with built-in memory were more time-efficient than camcorders without internal memory, for example. We also learned that supplying instructional materials using various media (text, audio, video) and on various platforms (paper, laptop, and iPod) led to the greatest use. And we discovered that providing and encouraging the use of digital technology supports (such as premade software tutorials) advanced just-in-time learning, independence, and problem solving.

Third, as with any lesson, you should aim to strike a balance between instructional design and instructional management. Even the greatest digital backpack and lesson design can fail if you don't give students appropriate instructional management. For instance, one problem we noted was that students wanted to develop such sophisticated products that they missed their delivery window. When designing instructional support materials, consider including support for project management. It's important to include project goals, timelines, and planning templates.

We encourage a backward design process infused with the UDL framework for creating backpacks to fit your needs. This process starts with the desired learning outcomes and then moves through designing specific tasks and determining the resources you need to facilitate these outcomes. The key is to develop an initial digital backpack that provides for targeted learning but maintains sufficient flexibility and scalability to be useful for multiple teachers and students.

For example, in our media-driven digital backpack for the Freedom Center, we first considered the content outcomes and the process objectives students would need to achieve these outcomes. Like any instructional plan, the design was balanced with the time and space constraints we had to work within, including the school day, transportation time, and the physical space of the Freedom Center. Once we defined these instructional guideposts, we planned the instruction, including a storyline and the tools and media the students would need to gain content information and technology support. This planning resulted in the use of digital videos, podcasts, and various digital and paper project

documents. To meet student needs at various levels, this information had to be engaging, accessible, and flexible. Finally, we planned a project workflow that scaffolded student work and project completion. As with any instructional plan, you can make adjustments during the project to ensure completion of desired outcomes.

The digital backpack provides a powerful, flexible, and teacher-friendly design for engaging learners of different ages, interests, and abilities. It supports learning across content areas and incorporates a meaningful experience to develop, refine, and assess students' digital age skills. Mission accomplished!

Resources

FUSION Center: www.cech.uc.edu/fusion

National Center for Universal Design for Learning: www.udlcenter.org

National Underground Railroad Freedom Center: www.freedomcenter.org

NETS•S: iste.org/standards/nets-for-students.aspx

Pasco's Sparkvue: www.pasco.com/sparkvue



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Helen Meyer is the director of the FUSION Center, a STEM education and outreach center at the University of Cincinnati, Ohio, USA. She is also the project director for the Woodrow Wilson Ohio teaching fellows program. Her teaching includes masters- and doctoral-level courses in teaching and learning.